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TRANSLATION

NEW METHOD OF IMPROVING THE MACHINABILITY OF CAST STEEL

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NEW METHOD OF IMPROVING THE MACHINABILITY OF CAST STEEL

S. V. Lominskiy

Until very recently the development of the study of metal cutting was chiefly confined to a study of the effect of the cutter type on the maching process, cutting speed, shaving size, and other external factors. In connection with this, the cutting process was usually improved by selecting optimum cutting regimes, changing the configuration of the cutters, improving the quality of the cooling-lubricating liquids, changing to high-speed cutting, etc.

We can approach this problem however, from the point of view of metal machinability.

The development of improved machinable metals is a problem of much theoretical and practical interest and the work of developing such metals is just as important for increasing productivity in metal cutting as developing new tool materials.

As is known, cast steel is more difficult to machine than rolled steel from the point of view of cutter life due to increased abrasive capacity causing increased wear of the cutters. In the Lathe and Tool

Laboratory of Machine Science and Automation Institute, Academy of Sciences, BSSR, they investigated the possibilities of increasing cast steel machinability by introducing sodium sulfus compounds into the ladle containing melted steel immediately before casting the metal into an ingot [1].

Experimental melts of steel type 45L were made in order to determine the most advantageous composition and quantity of sulfur compounds. Sodium sulfite Na_2SO_3, sodium metabisulfite $Na_2S_2O_5$, and a mixture of both compounds in various ratios were used as additives. Besides this, for a comparison, specimens were melted with additives of stick sulfur, ferrous sulfide FeS, and also sodium carbonate Na_2CO_3 was added to verify the hypothesis that as a result of the chemical reaction it (sodium without sulfur) will promote refining the cast steel of oxides and silicates, i.e., to render the same influence as sodium sulfur compounds.

There was from 0.3-0.4% sulfur in the cast specimens of the experimental melts. The content of the remaining elements was: 0.38-0.4% carbon, 0.6-0.7% manganese, 0.45-0.5% silicon, 0.027-0.03% phosphorus.

The basic machinability index, the level of expedient cutting speeds v_{60}, was determined by the accelerated method of end turning.

Investigations show that introducing sodium sulfur compounds into molten metal guarantees a significant improvement of cast steel machinability from the point of view of cutting speed (v_{60} increased up to 65% which is the same as increasing the resistance of the cutting instruments several times). It should be noted here that the stick sulfur additive even in a significant amount improves cast steel machinability much less than the sodium sulfite additive. This is completely attributed to the ferrous sulfide additive. The sodium

carbonate additive does not give significant results, hence, the additive sodium without sulfur does not cause chemical reactions which increase cast steel machinability.

A high sulfur content in steel usually causes deterioration of the mechanical properties of metal and the development of hot shortness. It is known that hot shortness tends to occur if ferrous sulfide FeS, which has a melting point of 1193° and, hence, will separate out as inclusions and film coatings along the boundary grain, is formed in the steel castings (if there is insufficient manganese). Only by bonding sulfur into manganese sulfide MnS and other sulfides not arranged as films and inclusions along the boundary grains, is it possible to obtain castings without cracks (2,3) at a higher sulfur content. For this purpose the manganese content in steel must be no less than 4 times the sulfur content. Manganese sulfide has a melting point of 1620° which is higher than steel. Owing to this, the manganese sulfide inclusions solidify earlier than the steel and remain not on the boundary grains but inside (they can even be nuclei of crystallization). This sulfur and manganese refractory compound protects the castings from hot shortness.

It was experimentally established that adding sodium sulfite in an amount which insures a sulfur content up to 0.1-0.13% does not lead to an intolerable deterioration of cast steel mechanical properties.

Taking into account that testing under laboratory conditions can not completely simulate machinability of castings for various operations durability tests were conducted under industrial conditions when machining the "Byelarus'" tractor bearing housing. The average life of the

hard-alloy instrument was increased 2.0-3.5 times* as a result of introducing sodium sulfite into these housings.

Thus, investigations which were repeatedly conducted both under laboratory and industrial conditions conclusively show that the cutting speed level when machining steel casting with sulfur additives is sharply increased, i.e., the rate of cutter wear is decreased. We know that the main factors affective in cutter dullness are the cutting temperature and the abrasive capacity of the metal being machined [4,5]. It was determined that a high sulfur content in the casting decreases the effect of these factors. The addition of sodium sulfide to the metal from the point of view of lowering the cutting temperature when machining steel casts to increase the life of the cutter, has the same effect as ample cooling. This is because the additives create on the rough spots of the contacting surfaces of the shavings and cutter a so-called easily shearable film which, so to speak, is an "internal lubricant" decreasing friction [6]. In all probability, the reduction of friction when cutting steel casting containing sodium sulfur additives can be attributed to manganese sulfide. To a certain extent they will soften during cutting and tend to smear, thereby creating a lubricant. The abrasive capacity of the casting containing sulfur additives is sharply decreased (2-3 times and more) which is explained by their low abrasiveness.

The latter is decreased because during the chemical reaction between the sodium sulfur additives and the molten metal, the steel

* The economic effectiveness of improving the machinability is apparent from the following calculations: the reduction of the costs for manufacturing and resharpening cutters just for 5 operations of machining these parts is 100 rubles per 1000 machines, while the additional.cost from adding sodium sulfite is only 30 rubles.

castings are freed from the silicon oxide SiO_2 and aluminum oxide Al_2O_3 abrasive inclusions, which is confirmed by slag analysis.

As is known, the machinability of metals cannot be characterized by any one particular parameter; it includes several characteristics. This includes, in addition to the cutter life and hence the cutting speed v_{60}, the magnitude of forces consumed during cutting and the smoothness of the machined surface.

An analysis of experimental data shows that the basic component of cutting power P_z (Fig. 1) of specimens containing high-sulfur additives is decreased by 15-20% and the machined surface simultaneously improves (Fig. 2), which makes it possible to exclude rough grinding under industrial conditions (instead of v_6 we can obtain v_7).

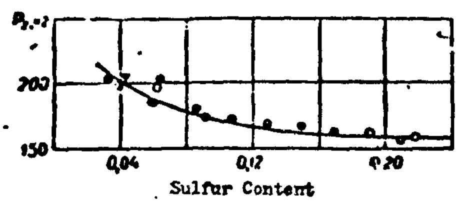

Fig. 1. Dependence of cutting power P_z on the sulfur content in castings.

These two indexes of machinability are improved mainly by decreasing the friction between shavings and the forward surface of the cutter.

On the basis of these investigations we can conclude that adding sodium sulfur to cast steel immediately before pouring it into molds is a very effective method of improving the machinability of steel castings.

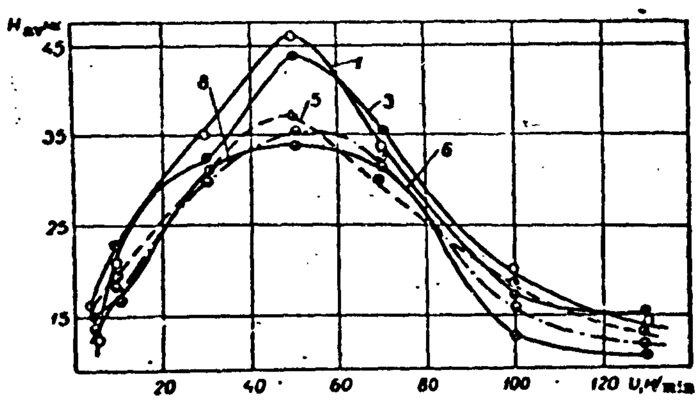

Fig. 2. Surface smoothness vs. cutting speed (number of curves corresponds to number of specimens).

REFERENCES

1. E. I. Fel'dshteyn and S. V. Lominskiy. Byull. tekhniko-ekonomicheskoy informatsii SNKh BSSR, 5, 1960.

2. B. N. Ladyzhenskiy and V. P. Tunkov. Vyplavka stali slya fasonnogo lit'ya, Mashgiz, 1954.

3. G. A. Kashchenko. Osnovy metallovedeniya, Metallurgizdat, 1950.

4. E. I. Fel'dshteyn. Obrabatyvaemost' staley, Mashgiz, 1953.

5. A. Ya. Artamonov. Issledovaniye obrabatyvayemosti vysokoprochnogo chuguna, Mashgiz, 1955.

6. S. P. Tambovtsev. Vliyaniye mikrostryktury metallov na ikh obrabatyvayemost', 1959.

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